UNIVERSITI PUTRA MALAYSIA

PROCESS IMPROVEMENT THROUGH SIX SIGMA METHODOLOGY - MV MACHINE DEFECTIVE REDUCTION

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By

ZALIZAN BIN MUID

Thesis Submitted in Fulfilment of the Requirements for
The Degree of Master Science in the
Faculty of Engineering,
University Putra Malaysia

April 2000

To my Beloved, Parents, Wife and Children:

You are the reason for all of this.

Abstract of thesis presented to the Senate of University Putra Malaysia in fulfilment of the requirements for the degree Master of Science.

PROCESS IMPROVEMENT THROUGH SIX SIGMA METHODOLOGY - MV MACHINE DEFECTIVE REDUCTION

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ZALIZAN BIN MUID

April 2000

Chairman : Ir. Haji Mohd Rasid Osman

Faculty : Engineering

Six Sigma tools and methodologies have innovated a solution for quality improvement. In Auto Mount Department of Sony Technology Malaysia in Bangi, Selangor, MV machine defective reduction project was performed as part of quality improvement efforts. Six Sigma tools and methodology were employed to conduct this project. This involved four simple but rigorous steps called Measure-Analyze-Improve-Control (MAIC) where tools such as Process Map, Measurement System Analysis (MSA), Cause and Effect Diagram, Failure Mode and Effect Analysis (FMEA), Fault Tree Analysis (FTA), Design of Experiment (DOE) and Statistical Process Control (SPC) were used. The objective was to obtain knowledge about sources of variability that cause the defects and then to improve process capability to attain Six Sigma capability. The sources of variability are the machine input factors such as nozzle, z-carriage, feeder cassette, XY table and head unit to generate corresponding outputs (i.e. defectives). Upon identifying the variables, actions were taken to eliminate and to control the identified

variability contributors. The project provides excellent insight into the power of Six Sigma as a process improvement tools. It provides significant process knowledge based on facts and data and facilitates the information sharing. As a result, the machine improved by more than 50%, which accounts for the annual savings of more than RM50,000.

Abstrak thesis yang dikemukakan kepada Senat University Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Master Sains.

PROCESS IMPROVEMENT THROUGH SIX SIGMA METHODOLOGY - MV MACHINE DEFECTIVE REDUCTION

Oleh

ZALIZAN BIN MUID

April 2000

Pengerusi : Ir. Haji Mohd Rasid Osman

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Kaedah Six Sigma dirumus khusus untuk meningkatkan kualiti. Sehubungan itu, jabatan Auto Mount di Sony Technology Malaysia di Bangi, Selangor, telah menjalankan projek "MV machine defective reduction" sebagai sebahagian daripada inisiatif untuk meningkatkan kualiti. Menerusinya, kaedah Six Sigma diterapkan dalam mengendalikan projek ini. Ianya melibatkan empat langkah yang kelihatan mudah tetapi rumit iaitu "Measure-Analyze-Improve-Control" (MAIC) yang merangkumi beberapa instrumen seperti "Process Map", "Measurement System Analysis" (MSA), "Cause and Effect Diagram", "Failure Mode and Effect Analysis" (FMEA), "Fault Tree Analysis" (FTA), "Design of Experiment" (DOE) dan "Statistical Process Control" (SPC). Matlamat projek ini adalah untuk mengenalpasti punca-punca variasi yang mencetuskan kemerosotan kualiti, disamping bertujuan meningkatkan keupayaan mesin MV. Punca-

punca variasi tersebut adalah input-input mesin itu sendiri seperti "nozzle", "z-carriage", "feeder cassette", "XY table" dan "head unit" yang bertindak menghasilkan output. Setelah mengenal pasti punca-punca variasi, tindakan diambil untuk menghapus dan mengawalselia pencetus-pencetus variasi yang dikenal pasti tadi. Sesungguhnya, projek ini berjaya menonjolkan keupayaan Six Sigma sebagai satu kaedah peningkatan proses yang unggul. Selain itu, ia juga menghasilkan satu proses "knowledge" yang penting, berteraskan fakta dan data serta memudahkan proses perkongsian maklumat. Akhirnya, kaedah ini berjaya meningkatkan keupayaan pengendalian operasinya 50% lebih cekap berbanding sebelumnya, yakni penjimatan kos tahunan melebihi RM50,000.

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An expression of appreciation is extended to my project Chairman, Tuan Haji Mohd Rasid Osman, and member of Supervisory Committee , Dr. Megat Mohammad Hamdan Megat Ahmad and Dr. Ir. Md Yusof Ismail, from the Department of Mechanical and Manufacturing, Engineering Faculty of University Putra Malaysia (UPM) for their guidance, and sharing of invaluable knowledge with me. Thank you also to Mr. Nashad Emir, a Six Sigma Master Black Belt, for his feedback and supplying suggestions for the success of the project.

A special thanks to HV Auto Mount Department of Sony Technology Malaysia Sdn. Bhd. for granting me the opportunity to conduct this project in the department. Sincere appreciation is expressed to HV Auto Mount engineers and technicians for their sharing of working experience and support. To Engineering Faculty, UPM, and the many others who have made contributions, please know that you have my thanks.

I certify that an Examination Committee met on 28th April, 2000 to conduct the final examination of Zalizan Bin Muid, on his Master of Science thesis entitled "Process Improvement Through Six Sigma Methodology - MV Machine Defective Reduction" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis was submitted to the Senate of University Putra Malaysia and was accepted as fulfilment of the requirements for the degree of Master of Science.

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Date: 13 JUL 2000

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any degree at UPM or other institutions.

(ZALIZAN BIN MUID)

Date: 24-5-2000

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LIST OF ABBREVIATIONS

ASQ	American Society for Quality
BB	Black Belts
CEO	Chief Executive Officer
COPQ	Cost of Poor Quality
CNX	Control - Noise - Experimental
CPC	Chip Placement Checker
DET	Detection
DOE	Design of Experiment
DPPM	Defect Part Per Million
FMEA	Failure Mode and Effect Analysis
FTA	Fault Tree Analysis
GB	Green Belts
GE	General Electric
HV	Home Video
IPO	Input-Process-Output
KISS	Keep It Simple Statistically
LCL	Lower Control Limit
LSL	Lower Spec Limit
MAIC	Measure - Analyze - Improve - Control
MSA	Measurement System Analysis

NG	No Good
OCC	Occurrences
PC	Pin Checker
PM	Preventive Maintenance
PPM	Positive Process Management
PWB	Printed Wiring Board
ROI	Return on Investment
RPN	Risk Priority Number
SEV	Severity
SOP	Standard Operating Procedure
SPC	Statistical Process Control
STM	Sony Technology Malaysia
UCL	Upper Control Limit
USL	Upper Spec Limit
UPM	University Putra Malaysia

CHAPTER I

INTRODUCTION

Project Background

For past several years industry has been bombarded with a plethora of quality improvement philosophies, tools and techniques which are often not fully explained or synthesized in a way that clearly depicts the "Big Picture." It seems like there has been a constant push to generate more and more pieces for the quality improvement puzzle without sufficient knowledge on how to put them all together properly (Berdine et al., 1998).

Some of the popular quality improvement tools and philosophies are Total Quality Management (TQM), ISO 9000, Baldrige Criteria, Statistical Process Control (SPC), Design of Experiment (DOE), Deming, Juran, Re-Engineering and Quality Function Deployment (QFD). These tools or philosophies create pieces of quality improvement puzzle. The questions are whether the pieces fit together or a set of disjointed pieces. The generation of this puzzle frustrates many people, managers in particular, who may lead the quality improvement efforts unsuccessful (Berdine et al., 1998).

The results of this puzzle can be seen in a manufacturing environment. Management would impose one idea after another without clearly explains how to solve the problems in an effective and systematic manner. The people who are working for the company or department are forced to follow the ideas or methods from the management, which sometimes created a lot of confusion, tension and stress. This environment stimulates fire fighting among the people and usually end up with an increased in quality defect level.

As in Auto Mount department of Sony Technology Malaysia Sdn. Bhd. (STM), quality defect level has hardly been improving. Many activities have been carried out, but there is no significant improvement in quality trend. Quality improvement efforts have made the employees very disillusioned. Management has come up with several policy, rules or guidelines such as back to basic, focus team, small group activity, audit program, production innovation, employee suggestion and bottom up versus top down to improve the quality, however, none of these activities seem to produce the desired result. The quality could be improved for a very short period as the trend went up back to its "comfort zone". Employees were extremely frustrated.

In addition, management continues to stress on quality improvement and sometimes blaming the employees for the level of quality produced. The puzzle of quality improvement is regenerated and sets of quality rules are re-emphasized. Nevertheless, employees do not seem to bother because the "history" has taught them.

SONY corporate management has innovated a solution for quality improvement. The management has launched Positive Process Management (PPM) in 1997 where this activity integrates ISO 9000 Quality System and Management of Process Performance through 6 Sigma methodology. The mission of the PPM activity is "Through Positive Process Management, Sony seeks to become the world reference in management quality, making a contribution to society through our business activities and delivering high quality products and services that conform to the requirements of our customers."
(PPM Activity Promotion Office, 1998)

In order to kick off the PPM activity for Auto Mount department, a project to reduce Auto Mount defective was selected. This project was set as an example of how Six Sigma methodologies can be applied for process improvement.

Six Sigma methodologies have motivated the employees to continue the effort of quality improvement. It provides the tools to accomplish the task. It is the process of continued learning and the application of proven methodologies for today's companies to gain the knowledge required to sustain leading positions in world technology, production and service (Schmidt et al., 1998).

Problem Definition

A drive to improve quality continuously has been an important performance measure in any industry especially in manufacturing. In STM, the company quality policy "Customer Satisfaction by Everyone, Zero Complaint and Zero Defect" is the goal for every employee. Every department, starting from Auto Mounting, the first process, until final inspection in General Assembly has set an aggressive quality target as one of the most important challenge for success.

In Auto Mounting department, many types of machines are used to insert or mount components onto PWB (Printed Wiring Board). The following illustrates the process flow that describes the Auto Mount process.

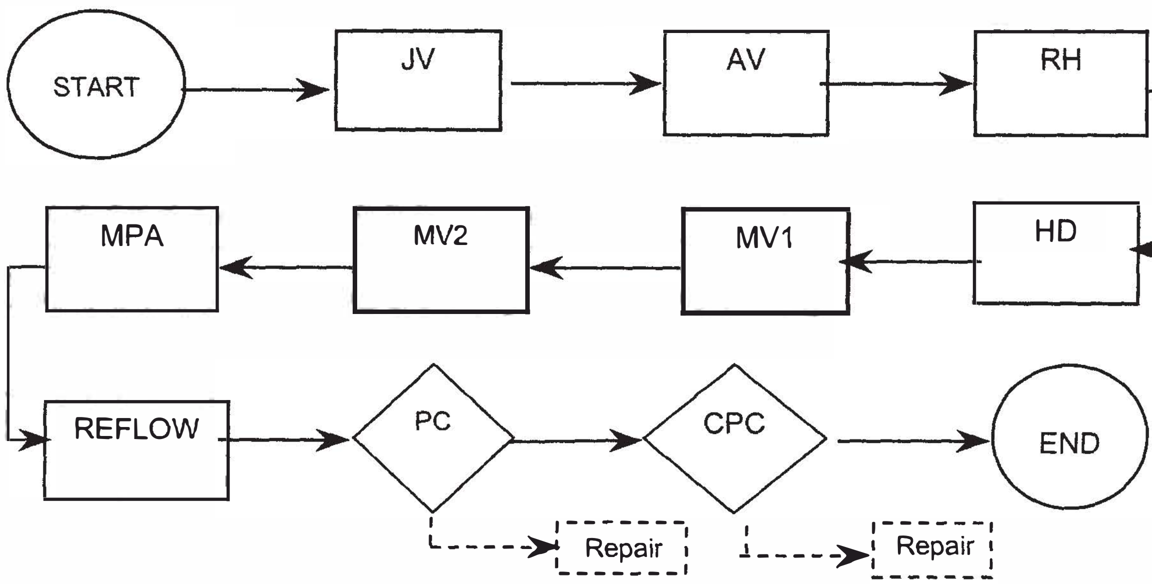

Figure 1: Auto Mount Process Flow

Auto Mount process involves five main machines: JV, AV, RH insertion and CHIP mounting. CHIP mounting process consists of HD, MV1, MV2, MPA and .eflow machine. There are 14 lines of CHIP mounting process in the department. At the end of the process, the Pin Checker (PC) and the Chip Placement Checker (CPC) will inspect the PWB quality. The inspection results measure the output of the process. If one or more of the mounted components in the PWB fail to comply the quality specifications, the PWB will be rejected and it will be sent for repair. The performance of the machine depends on the number of mounted components that meet the quality specifications. The quality performance is measured in defect parts per million (dppm).

Auto Mount quality trends between April 1998 to March 1999 is shown on Table 1.

Table 1: Defective Breakdown for Auto Mount Department

Defectives	April'98 – September'98 (Unit Parts)	October'98 – March'99 (Unit Parts)
JV Missing	4961	3212
AV Missing	5962	5705
RH Missing	14660	12141
Chip Missing	11729	9317
Shifted	6275	7675
Standing	4852	2718
Position Out	**20457**	**22501**
IC Zure	4849	3789
Bara-Bara	482	571
Others	2417	1478
Total	76644	67107

(Source: Auto Mount Department, 1999)

As can be seen Table 1, position out defective has been the top defective for this department. This defective is produced in chip mounting process. The diagram of Position Out defects is shown in Figure 2:

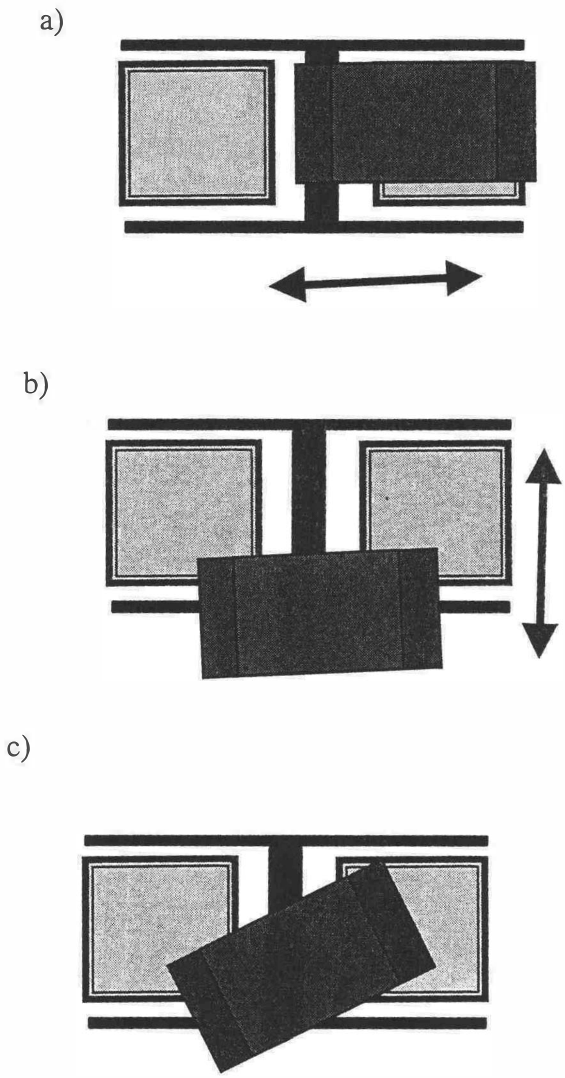

Figure 2: Position Out defects (a) X Position Out; (b) Y Position Out; (c) θ Position Out (HV Auto Mount Department, 1999)